

## THE MANITOBA SUGAR INDUSTRY

### Sugar is a Product of Sunshine and Green Leaves

More than a hundred different kinds of sugar are known to science, each with its own name and chemical formula. Every plant with green leaves produces sugar of some kind, always composed of carbon, hydrogen and water and known as a carbohydrate. The granulated white sugar we use at the table is known to the chemist as sucrose. It may be obtained from a number of well known plants, but is obtained commercially in very great quantity from two plants only, sugar beets and sugar cane. Refined sugar from cane and sugar beets, are identical with the same chemical formula  $C_{12}H_{22}O_{11}$ .

The green pigment, chlorophyll, which gives color to grasses and leaves, is the key to nature's production of sugar. Chlorophyll is the essential agent which combines with air, water and sunlight to produce sugar. The roots of the plant take up large quantities of water from the soil. This moisture moves up through the plant to be finally given off into the air through pores in the leaves. Through these same pores carbon dioxide from the air enters the leaf. When sunlight shines on the leaves, the miracle occurs - carbon and water are combined to form sugar. This process of nature's is known as photosynthesis.

### Some Early History

Sweet juices from sugar cane were first recognized in India before the Christian era and are mentioned in the sacred books of Brahmanism. The date when sugar first appeared in crystalline form is now known. There are references to cane sugar in the Bible, one of which may be found in Jeremiah VI - 20. Crusaders nearly a thousand years ago brought back to England from Arabia both the name sugar and the sugar itself which was then very imperfectly refined and produced in very small quantities. Originally it was regarded as a valuable medicine.

Refining of sugar in the modern sense did not begin until the fourteenth century, but by the year 1500 it had become an important article of international trade. Prices were very high which made sugar available only to the wealthy. Queen Elizabeth I is credited with introducing the custom of having a bowl of sugar on the table.

High prices charged for sugar by the merchants of Venice who had a monopoly of the trade at this time led to competition from the Portuguese who introduced sugar cane to the island of Madeira. Columbus took sugar cane plantings on his voyage of discovery of the new world and expressed satisfaction at the way the sugar canes took root. Supplies from the West Indies and South America increased and prices declined until sugar became part of everyone's diet.

#### Sugar Prices in Canada

Today Canadians enjoy sugar at a very moderate price. Just over 80 percent of the sugar used in Canada is cane sugar grown in sub-tropical countries such as the West Indies, Fiji, Australia, etc. Most of these countries sell their sugar on agreements at guaranteed high prices that ensure an ample supply of sugar. Sugar produced in excess of that required to fulfill the agreements is sold on the Free World Market at a price dependant upon the supply and demand in this market. It is from this market that Canadian Cane Refineries buy their raw cane sugar and thus the price on the World Market, sets the price of sugar in Canada. Because the quantity of sugar traded on the Free World Market is small in relation to the total world supply, the price may vary widely during times of international conflict or because of shortages or over abundant production. The Korean War in 1951 and 1952 and the Suez Crisis in 1957 are examples of events that have dramatically increased sugar prices. However, over-production and low prices is the normal conditions prevailing and in the past 50 years the retail price of sugar in Canada has seldom exceeded 10 cents per pound according

to the Dominion Bureau of Statistics. The average consumption of sugar in Canada is about 97 pounds per person per year. Less than half of this amount (40 pounds) is brought as refined sugar in the grocery store and the remainder is consumed in confectionary, soft drinks, and bakery goods. Thus the housewife spends about \$4.00 per person for a year's supply of sugar--or less than the price of a candy bar each week!

### Sugar from Sugar Beets

In 1747, Andreas Marggraf, a German chemist, proved the existance in beet roots and carrots, of sugar identical to the well known sugar from cane. However, for more than fifty years no further advance was made in this field. The real stimulus to beet sugar production was given by Napoleon. In 1811 the French found themselves cut off by the British fleet from the sugar that usually came from the West Indies, and the price of sugar had risen to more than a dollar per pound. Moreover, Napoleon needed sugar for his armies. He is the author of the statement, "an army marches on its stomach", and sugar has always been recognized for its readily available food energy. When Napoleon learned that sugar could be obtained from beets, he took immediate action. In 1812 France had 79,000 acres growing sugar beets and some thirty small factories processing beet sugar.

Waterloo put a temporary end to beet sugar production. Sugar flowed in again from the West Indies. However, it had been learned that sugar beets have an important place in agriculture and by the middle 1830's the beet sugar industry was re-established in France on a sound and permanent basis.

In 1836 beet sugar production was first attempted in the United States, having been brought there from France. However, for more than forty years, there was an unbroken succession of failures in the techniques of beet sugar processing. It was not until 1870 that the first successful plant was established at Alvarado

in California, but from that date progress was rapid. The century closed with thirty sugar processing plants operating in Western United States. Now there are 61 factories in the U. S. operating in 18 states from Maine to the west coast. About 40,000 farmers cultivate around 1,300,000 acres of sugar beets from which is produced annually more than two million tons of beet sugar.

#### Beet Sugar Production Comes to Canada

Interest in sugar beet growing naturally spread to Canada. In 1902 the first Canadian processing plant was built in Wallaceburg, Ontario. In 1903 a plant was built in Alberta. This plant was closed and dismantled in 1915 but was rebuilt under new ownership in 1925. The Manitoba Sugar Company plant in Fort Garry was opened in 1940 after more than twenty years of investigation and experimentation. There are now five beet sugar plants in Canada producing about 20% of the sugar consumed in Canada. Alberta has two plants at Picture Butte and Taber, in the southern part of the province where irrigation is available. Manitoba has one plant at Fort Garry; Ontario one at Chatham; and Quebec one near Montreal. About 80% of the sugar used in the three prairie provinces is from sugar beets grown in Alberta and Manitoba.

#### Sugar Beet Growing In Manitoba

When the Manitoba Sugar Company first started operations in 1940, sugar beets were grown on all soil types to be found in the Red River Valley. However, there has been a steady shift from heavy clay soil to lighter loam and sandy loam soil. Beets will grow satisfactorily in heavy clay soils, but the difficulty of operating machinery after rains resulted in the shift to lighter land. About two-thirds of the Manitoba sugar beets are now grown in the southern part of the province in the Letellier-Emerson-Altona-Winkler, area. The Portage la Prairie area has had on the average the heaviest yield per acre. A few beets are grown as far north as Teulon. All sugar beets are grown within about 70 miles

from the processing plant on account of heavy freight on the beets.

### Contract Farming

Each beet grower has a contract with the company for cultivation of an agreed number of acres of sugar beets. This contract assures the grower a supply of thoroughly tested seed and fertilizer, with guidance and advice from experienced agricultural and field staff supplied by the company. It also assures him a ready market for his beets with prompt cash payment. The contract assures the company a supply of beets for the factory. Payment for the beets is on a share basis. Out of every 100 pounds of sugar produced, the grower's share is about 61 pounds. Three-quarters of the estimated value is paid when the beets are delivered, the remainder in three installments. Final payment is made when the year's production of sugar is sold.

Acreage contracts range from 5 acres to 250 acres with about fifteen to twenty growers contracting for 100 acres or more and each producing more than 1,000 tons of beets. Due to the increase in mechanization and the heavy cost of machinery the trend has been to an increase in the size of individual contracts. In 1940, 1,169 farmers contracted to cultivate 19,968 acres, an average of a little over 17 acres per farmer. In 1966, 617 growers contracted to cultivate 29,000 acres, an average of 47 acres per farmer.

### Seeding, Thinning, and Cultivation

Sugar beets are usually grown on summerfallow. Very careful cultivation is practised in order to conserve moisture and prevent soil drifting. Many beet growing areas have irrigation but the normal rainfall on our fertile Red River Valley soil is sufficient for beet growing if careful cultivation is maintained. Seeding starts not earlier than May 1st in order to avoid damage from frost. Seeds are planted not more than  $1\frac{1}{2}$ " deep, 2" apart and in rows 22" to 24" apart.

Seed, specially developed for our northern climate, and fertilizer are supplied by the company to be paid for by the growers from the oncoming crop.

About a month after the seeds are planted the work of thinning begins. Seeds are planted two inches apart but the beet must be thinned to about 12" spacing in the row to obtain full growth. In this thinning operation weeds must be removed as well as excess beets. Efficient machines for thinning are available and are becoming more generally used.

Cultivation between the rows normally starts as soon as the young beets appear above the ground. Here again a double objective is sought, removal of weeds and prevention of soil drifting. Beets are cultivated once, sometimes twice, before thinning starts. In this machine cultivation between the rows, only a very narrow band of 2" or less is left uncultivated down the row of beets, thereby reducing the amount of weeding necessary in the row. Beets are cultivated two or three times after thinning, continuing until the leaves from one row meet the leaves from the next row.

### Harvesting

Harvest starts during the last week of September, reaches its peak early in October and is normally completed by the 20th of October. The percentage of sugar in the beets depends on the weather and particularly on harvest weather. Warm, sunny days and cool nights are favourable to accumulation of sugar in the beet. A severe autumn frost of 10° or more will stop growth and any further storage of sugar.

Originally beets were harvested with a great deal of hard labor. Now 100% of the crop is harvested by machine. Two men with two machines - one cutting off tops, the other lifting three rows of beets - will harvest as many acres in one day as were harvested by fifty men twenty years ago. At peak harvest season as many as fifteen to twenty thousand tons of beets will arrive in a single

day at the factory and the 13 receiving stations scattered throughout the beet growing area. Within a radius of 40 miles beets are normally brought to the factory by truck; beyond this distance they are shipped by rail. At the factory and at two receiving stations beets are stored in massive piles which are mechanically ventilated to keep the beets cool and fresh, thereby conserving sugar.

For the years 1957 to 1966 the average yield of sugar beets in Manitoba was 10.11 tons per acre. The average yield in Alberta, due to availability of irrigation, 13.5 tons per acre. Irrigation, however, adds to the cost of production. Yield in Ontario, with a longer growing season and more abundant rainfall than in Manitoba, is still higher than in Alberta. In Manitoba yields are limited by a short growing season and moderate rainfall. Total cost of production will vary from \$80 to \$100 per acre.

#### Research

Agricultural research has been carried on continuously by The Manitoba Sugar Company since the opening of the plant in 1940. Chief items of research are the testing of beet varieties to determine suitability to our soil and climate, the testing of fertilizers including kinds, rate of application and placement, and all cultural practices. Beets harvested in the experimental test plot are analyzed in the plant research laboratories. The company also collaborates with The University of Manitoba and chemical companies in testing new insecticides and herbicides specially related to sugar beet growing. In addition to this highly necessary local work, all beet companies of Canada and U. S. A. are members of the Beet Sugar Development Foundation. This organization carries out a research program at Universities and Government Agricultural Research Stations with an annual outlay of \$175,000. The Canadian Sugar Institute was founded in 1966 to co-operate in research and other matters pertaining to the sugar industry in Canada.

An example of the nature of sugar beet research may be seen in the continuous effort to produce better seed. In 1940, when the whole multigerm beet seed was planted, five or six plants came up in a cluster. The work of thinning this cluster to one beet by using a short handled hoe was very laborious. A machine was developed to break up the seed ball into sections, each having one to three seeds. Fewer seeds germinated from each section and thinning was made easier. Plant scientists have now produced a monogerm seed from which a single plant emerges permitting mechanization of the thinning operation.

#### 4-H Sugar Beet Clubs

The first 4-H Sugar Beet Clubs in Manitoba were formed in 1956 with 21 members in two clubs. In 1966 there were 11 clubs and 154 members. Each club has a contract with The Manitoba Sugar Company and each member has a contract with the club to grow one acre of sugar beets. Prizes are given for highest general proficiency, for the best beet plot and for the best set of records. The activities and special training of 4-H Sugar Beet Club members give excellent promise for future sugar beet growing in Manitoba.

#### Benefits

Sugar beet growing has been a valuable addition to Manitoba agriculture. Soil fertility is maintained by use of green manures and commercial fertilizer. Thorough cultivation results in the nearest approach to weed-free land making it suitable for the production of registered seed grain. The equipment necessary and experience gained fit in well with production of other row crops, especially corn and sunflowers. The fleshy root of the sugar beets extends 10 to 15 inches into the soil and sends fibrous rootlets down several feet to feed on soil untouched by most other crops. Because it penetrates and aerates the land the beet has very special value as part of the crop rotation.

Aside from the colateral benefits mentioned above, sugar beets are in themselves a very valuable crop. An average crop in Manitoba will yield about ten tons of beets per acre, which will produce around 2,500 pounds of sugar. In addition, there are two valuable by-products, dried pulp and molasses. From the 1966 sugar beet crop 6,000 tons of molasses and 17,000 tons of dried beet pulp were produced. These by-products form an important part of rations for both dairy and beef cattle. The entire production finds a ready market in the livestock industry in Manitoba and Saskatchewan.

In 1966 Manitoba beet growers contracted to cultivate slightly over 29,000 acres of sugar beets. Under normal growing conditions this would result in the production of nearly 75 million pounds of sugar. Total value of the sugar crop and the by-products would amount to about \$7,500,000. No other crop grown on this scale in our western agriculture can produce a harvest equal in value per acre to that of sugar beets.

In addition to making possible the production of a new and valuable crop for Manitoba, The Manitoba Sugar Company's plant in Fort Garry provides employment on a fairly large scale, with an annual payroll of over \$800,000. There are about 90 full-time employees, about 15 of them in office administration and 75 in factory and agricultural operations. The number increases to nearly 400 during the three months processing season called the "campaign". Of nearly 300 seasonal employees around 70% are from farms where the grain harvest has been completed.

To labour employed by the Company may be added the labour employed by the growers. Total wage bill on the farms for a crop of 29,000 acres of sugar beets will come to approximately \$850,000.

#### Plant Improvement:

More than four and three-quarter million dollars were invested between

1955 and 1966 in modernizing and improving the processing plant and its equipment. Dominant among the changes made was the installation of modern equipment thereby insuring both increased production and improved quality of product. In 1956 a complete new sugar drying and screening station was installed to ensure uniformity in the sugar grain, an important factor in precision cooking.

Changes made have resulted in a marked increase in the daily production capacity of the plant. In 1954 an average of 1,940 tons of beets were processed per day. In 1966 this had been increased to 2,850 tons per day. Increased production naturally created a need for increased sugar storage and shipping facilities. In 1962 three concrete silos or storage bins, 50 feet in diameter and 150 feet high, at a cost of \$640,000 were built to store thirty million pounds of sugar. These bins are lined with wood and equipped with conditioned air systems which pass dry warm air around and through the sugar keeping it free from moisture and preventing caking or lumping of the sugar.

In 1963 a new continuous diffuser was installed at a cost of \$550,000, to provide a more efficient method of extraction than was possible with the older type of equipment. Equipment to pelletize the dried beet pulp was installed in 1964. Beet pulp pellets are much easier to handle with conventional conveying equipment and require only 1/3 the storage space of bagged pulp.

In 1965 a Flume Water Clarification System was installed at a cost of over \$250,000 to allow the re-use of 5 million gallons of water per day required for fluming beets. This installation eliminated the discharge of waste water to the Red River, a very important contribution to the program of river pollution control.

The continuing program of improvements ensures an efficient operation and products of the highest quality.